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BACKGROUND STUDY FOR MOTOR VEHICLE EMISSIONS INSPECTION AND MAINTENANCE PROGRAM FOR PULASKI COUNTY, ARKANSAS

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The report documents general information on motor vehicle inspection and maintenance (I/M) with respect to Pulaski County Arkansas. A background discussion of events leading to the need for an I/M program in Pulaski County is provided. A general description of I/M is provided with respect to types of programs, the benefits of I/M, and information on implementation activities. Expected hydrocarbon emission reductions are included.

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SECTION 1

INTRODUCTION

The purpose of this report is to provide a description of several inspection and maintenance (I/M) program options that may be implemented in Pulaski County, Arkansas. This report supplements an earlier report which provides a general description of I/M programs. An I/M program is required by the 1977 Clean Air Act Amendments for those urban areas which are not expected to attain the ambient air quality standard for photochemical oxidants by December 31, 1982. Based on air quality levels of photochemical oxidants recorded in the cities of Little Rock and North Little Rock during 1977, the Environmental Protection Agency declared Pulaski County as a non-attainment area for this pollutant. In order to attain the photochemical oxidant standard in this area, a program for reducing emissions of volatile organic compounds (VOC) will be implemented which consists primarily of the application of reasonably available control technology to stationary sources. Significant emission reductions will also be achieved from motor vehicles through the Federal Motor Vehicle Emissions Control Program. In those areas where sufficient emission reductions cannot be achieved to attain the standard, an I/M program will be required. The I/M program has as its purpose a method to periodically monitor motor vehicle emissions to determine if they are meeting a prescribed standard and to require repair of the vehicle to the extent necessary to meet the emission limit.

The Environmental Protection Agency recently relaxed the ambient air quality standard for photochemical oxidants which changed the non-attainment status of several urban areas and reduced the level of emission reduction required in other areas. In Pulaski County, an I/M program may no longer be needed, depending upon the emission reductions that can be achieved by 1982.

This report discusses the background to the development of I/M programs, specifically the legislative authority. It also presents a discussion of the motor vehicle emission reductions that can be achieved by I/M and a comparative analysis of several program options and costs.

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SECTION 2

BACKGROUND

2.1 LEGISLATIVE AUTHORITY

Under the Clean Air Act Amendments of 1967, the National Air Pollution Control Administration was required to publish air quality criteria necessary for the protection of the public health and welfare. These criteria described the relationship between atmospheric concentrations of pollutants and their effects on human health and the environment. The 1970 amendments to the Clean Air Act required the Environmental Protection Agency (EPA) to promulgate National Ambient Air Quality Standards (NAAQS) for each air pollutant for which air quality criteria had previously been issued. Air quality standards were established for photochemical oxidants as well as sulfur dioxide, nitrogen dioxide, carbon monoxide, non-methane hydrocarbons, and total suspended particulates. Primary standards for these pollutants were set at a level to protect human health, while secondary standards were set at a level to protect plant and animal life, as well as prevent damage to materials.

After promulgation of the standards, each state and territory was required to submit to EPA a State Implementation Plan (SIP) which described the course of action that the state would adopt in order to attain the standards and the proposed attainment date. The latest date for attainment was set at July 1975. Since there were many areas in the country that were not attaining the standards, the 1977 amendments to the Clean Air Act specifically addressed those "non-attainment" areas in Section 172 of the amendments[1]. Each state was required by the amendments to submit a reivsed SIP by January 1, 1979, which showed attainment of the standards no later than December 31, 1982. For photochemical oxidants, the SIP must show adequate reduction of volatile organic compound (VOC) emissions as they are precursors to the formation of ozone, a major component of photochemical oxidants. Volatile organic compounds are the major component of motor vehicle exhaust hydrocarbon emissions. An extension of the attainment date for photochemical oxidants and carbon monoxide may be granted if demonstration of attainment cannot be shown by 1982 with the application of

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reasonably available control technology for stationary sources. In order to obtain the extension to 1987, the revised SIP must contain a schedule for the implementation of a motor vehicle emission inspection and maintenance program. Under the requirements of the law, the EPA Administrator may impose sanctions if the states fail to comply with the requirements for standard attainment. These sanctions include disapproval of grants for highway funds except for safety, mass transit or transportation improvement projects related to improvement for maintenance of air quality. If a state or local government is not implementing an SIP, they cannot receive any grants under the Clean Air Act. Federal agencies are required not to take any action including making any grant that does not conform to an approved SIP. In addition, no metropolitan planning agency shall give its approval to any project, program or plan which does not conform to an approved SIP. The Act also requires that priority be given for programs with air quality transportation consequences to the implementation of SIP's necessary to achieve and maintain air quality standards.

The ambient air quality standard for ozone was recently relaxed; therefore, an I/M program may not be needed since the standard will probably be attained by 1982. If an I/M program is adopted, it will be used for the control of hydrocarbon emissions since these pollutants are a major contributor to the formation of ozone, the main component of photochemical oxidants. A beneficial effect on lowering carbon monoxide levels will also occur since many of the repairs or adjustments made to motor vehicles result in the reduction of both pollutants.

2.2 PULASKI COUNTY NON-ATTAINMENT STATUS

The 1977 Clean Air Act Amendments define a non-attainment area as an area which is shown by monitored data or which is calculated by air quality modeling (or other methods determined by the Administrator to be reliable) to exceed any national ambient air quality standard for such pollutant. During a three-month air monitoring program during 1977 in Pulaski County, ozone levels in excess of the former one-hour standard of 0.08 ppm were reported in the area of the City of Little Rock. Air quality levels recorded during this period were at 0.15 ppm, which is still in violation of the recently promulgated standard of 0.12 ppm. In developing a control strategy for reducing volatile organic compound emissions, it

was found that emissions in 1982 could not be reduced to a level sufficient for attainment of the former standard but may be sufficient for the revised standard.

In determining the emission levels for both 1977 and 1982, an inventory of the volatile organic compound emissions in 1977 from all sources was compiled for Pulaski County[2]. The results of this inventory indicated that there were very few stationary sources of VOC in the county, most of these being gasoline terminals. Mobile sources comprise the largest source of VOC emissions with motor vehicles accounting for approximately 57% of the total VOC emissions in the county. Table 2-1 presents a summary of VOC emissions from all sources. Since motor vehicles are the largest source of emissions, they also provide the greatest potential for emission reduction.

TABLE 2-1. PULASKI COUNTY VOC EMISSIONS FOR 1977

STATIONARY SOURCES		VOC EMISSIONS (TONS/YEAR)			
		STATIONARY POINT SOURCE EMISSIONS	STATIONARY AREA SOURCE EMISSIONS	MOBILE SOURCE EMISSIONS	TOTAL BASE YEAR EMISSIONS 1977
PETROLEUM REFINERIES	REFINERY FUGITIVES (LEAKS)				
	MISCELLANEOUS SOURCES A. PROCESS DRAINS AND WASTE B. VACUUM PRODUCING SYSTEMS C. PROCESS UNIT BLOWDOWN				
	OTHER				
STORAGE, TRANSPORTATION & MARKETING OF PETROLEUM PRODUCTS	OIL & GAS PRODUCTION FIELDS				
	NATURAL GAS AND NATURAL GASOLINE PROCESSING PLANTS				
	GASOLINE & CRUDE OIL STORAGE[1]				
	SHIP AND BARGE TRANSFER OF GASOLINE, CRUDE OIL, AND CHEMICALS		0.2		0.2
	BULK GASOLINE TERMINALS[2]	829.0			829.0
	GASOLINE BULK PLANTS[3]	120.7			120.7
	SERVICE STATION LOADING		987.1		987.1
	SERVICE STATION UNLOADING		766.0		766.0
	AVIATION GASOLINE HANDLING		110.8		110.8
INDUSTRIAL PROCESSES	ORGANIC CHEMICAL MANUFACTURE				
	PAINT MANUFACTURE	7.0			7.0
	VEGETABLE OIL PROCESSING	151.2			151.2
	PHARMACEUTICAL MANUFACTURE				
	PLASTIC PRODUCTS MANUFACTURE	335.6			335.6
	RUBBER PRODUCTS MANUFACTURE	62.8			62.8
	TEXTILE POLYMERS MANUFACTURE	43.6			43.6
	OTHERS	1.9			1.9
INDUSTRIAL SURFACE COATING	LARGE APPLIANCES		5.7		5.7
	MAGNET WIRE		182.4		182.4
	AUTOMOBILES		41.2		41.2
	CANS		14.1		14.1
	METAL COILS				
	PAPER	22.4	358.0		380.4
	FABRIC		163.7		163.7
	METAL FURNITURE				
	WOOD FURNITURE	144.0	44.1		188.1
	FLAT WOOD PRODUCTS	1.2	51.1		52.3
	OTHER METAL PRODUCTS	135.6	200.0		335.6
	OTHERS	1.2	352.8		354.0
NON-INDUSTRIAL SURFACE COATINGS	ARCHITECTURAL COATINGS		113.0		113.0
	AUTO REFINISHING	7.4	90.7		98.1
	OTHERS				
OTHER SOLVENT USE	DEGREASING	5.7	182.1		187.8
	DRY CLEANING		152.2		152.2
	GRAPHIC ARTS	34.2	950.6		984.8
	ADHESIVES				
	CUTBACK ASPHALT		0.0		0.0
	OTHER SOLVENT USE		3,726.5		3,726.5
OTHER MISCELLANEOUS	FUEL COMBUSTION				
	SOLID WASTE DISPOSAL				
	FOREST, AGRICULTURAL, AND OTHER OPEN BURNING		105.1		105.1
TOTAL VOC EMISSIONS FROM STATIONARY SOURCES		1,903.5	8,597.4		10,500.9
MOBILE SOURCES	HIGHWAY VEHICLES			16,657.3	16,657.3
	OFF-RIGHWAY VEHICLES			195.5	195.5
	RAIL			74.0	74.0
	AIRCRAFT			749.0	749.0
	VESSELS AND PLEASURE CRAFT			1,006.9	1,006.9
TOTAL VOC EMISSIONS FROM MOBILE SOURCES				18,682.7	
TOTAL VOLATILE ORGANIC COMPOUND EMISSIONS		1,903.5	8,597.4	18,682.7	29,183.6

[1] INCLUDES ALL STORAGE FACILITIES EXCEPT THOSE AT SERVICE STATIONS AND BULK PLANTS.
[2] EMISSIONS FROM LOADING TANK TRUCKS AND RAIL CARS.
[3] EMISSIONS FROM STORAGE AND TRANSFER OPERATIONS.

SECTION 3

INSPECTION AND MAINTENANCE PROGRAM EMISSION REDUCTIONS

3.1 EMISSION REDUCTION REQUIREMENTS OF I/M PROGRAM

3.1.1 Background

It is not a requirement of the I/M program to reduce motor vehicle emissions to the level where Pulaski County could attain the primary standard for photochemical oxidants. The I/M programs must produce at least a 25 percent reduction in light duty vehicle (LDV) exhaust emissions of hydrocarbons by December 31, 1987, compared to the emissions level without I/M on the basis of the most recent motor vehicle emission factors. Emission factors are the amount of pollutant (in gms/mile) that a highway motor vehicle will emit.

Emissions of volatile organic compounds (VOC) from highway motor vehicles are calculated by multiplying the appropriate emission factor for highway motor vehicles (or in this case just light duty vehicles) times the vehicle miles of travel (VMT). Therefore, the equation used to calculate VOC emissions from highway motor vehicles is:

$$\text{VOC Emissions (tons/year)} = E_f \times \text{VMT} \times 365 \text{ days/year} \div 907{,}180 \text{ gms/ton}$$

where: E_f = Emission factor calculated from Mobile Source Emissions Model[3]

VMT = Vehicle miles of travel per day

Since the vehicle miles of travel will be constant for any given year, a direct comparison of the light duty exhaust emission factors before and after I/M can be used as the criterion to check if I/M requirements are met.

3.1.2 Light Duty Vehicle Exhaust Emissions

3.1.2.1 LDV Exhaust Emission Factor for 1987 Without I/M

The 1987 LDV exhaust emission factor was calculated using Mobile 1: Mobile Source Emissions Model[3] and was found to be 0.968 gms/mile. This was calculated at a weighted average speed of 43.6 mph. The average weighted speed of 43.6 mph was calculated by weighting the VMT

(vehicle miles of travel) traveled at each of the eight different roadway speeds (25, 30, 40, 45, 53.5, 55.8, 57.8 and 60.3 mph) assumed for the state highway system and local roadtype classifications. These assumptions were based on data obtained from the Arkansas State Highway and Transportation Department[4]. The average weighted speed was calculated by taking the ratio of VMT at each speed to the total VMT for Pulaski County and multiplying it by the corresponding speed. Summing the above function for all eight speeds gives the average weighted speed (by VMT) for Pulaski County. Other input data into Mobile 1 are the same as in the Volatile Organic Compound Emission Inventory for Pulaski County, Arkansas, and can be found in Table A-1 in the Appendix.

The LDV exhaust emission factor required for 1987 if an inspection and maintenance program is incorporated is calculated as follows:

1987 LDV E_f (with I/M) = 0.968 - (0.968)(0.25) = 0.726 gms/mile

The following section will give the light duty vehicle VOC exhaust emission factor with an inspection and maintenance program on light duty vehicles.

3.1.2.2 Exhaust Emission Factor for 1987 With Inspection and Maintenance on LDV

In order to meet the minimum requirement of an inspection and maintenance program, an LDV exhaust emission factor of 0.726 gms/mile (as previously shown) is required. The 1987 LDV exhaust emission factors were calculated with inspection maintenance starting dates of 1981, 1982 and 1983. Startup dates for I/M programs are dependent upon two factors: (1) legislative action, and (2) whether centralized or decentralized inspection facilities are selected, as each has a different implementation schedule. The date of legislative action affects the starting dates of the programs as shown on Table 3-1. The same average weighted speed (43.6 mph) was used to calculate LDV emission factors with I/M. All other data included (data not pertaining to the I/M program) were the same as used before and can be found in Appendix A.

TABLE 3-1. SUMMARY OF I/M STARTING DATES

LEGISLATIVE ACTION	INSPECTION AND MAINTENANCE PROGRAM BEGINS	
	CENTRALIZED FACILITY	DECENTRALIZED FACILITY
June 30, 1979	December 31, 1981	December 31, 1980
July 31, 1980	December 31, 1982	December 31, 1981

The data needed to input into the mobile source emissions model for an I/M program are the following:

- The calendar year of interest
- Year of I/M program implementation
- Stringency level of I/M program
- Whether mechanic training is an integral part of I/M program
- Earliest model year to be included in I/M program
- Latest model year to be included in I/M program.

The calendar year for which LDV emission factors are being calculated (1987), and the year I/M begins (1981, 1982 or 1983) have already been discussed. The stringency factors analyzed varied from 10 to 50 percent. The stringency factor is the percentage of total vehicles tested in an I/M program in a given time period that fail the inspection and require maintenance and repair. In all cases it was assumed that mechanics training would be incorporated into the program to insure program effectiveness and for consumer protection.

By varying the earliest model year vehicle to be included in the I/M program, and holding all other factors constant, it was found that including vehicles prior to the 1972 model year does not have a significant impact on the 1987 emission factor. It was also determined that the 1987 emission factor increased for each year after 1972 that was included as the model year. The results of varying the beginning model year are shown in Table A-2. The latest model years to be included in the I/M program that were analyzed were 1986 and 1987. No difference in the 1987 LDV exhaust emission factor was found when either of these two years was

used as the latest model year (results are in Table A-3). Therefore, all analyses for the I/M program were done with the latest model year included being 1986.

The minimum stringency requirements needed for the LDV I/M program to meet the 0.726 gms/mile exhaust emission factor required in 1987 for LDV are summarized in Table 3-2.

TABLE 3-2. MINIMUM STRINGENCY REQUIREMENTS OF LDV I/M PROGRAM[(a)]

I/M BEGINS (Year)	STRINGENCY FACTOR	LDV EXHAUST EMISSION FACTOR (gms/mile)
1981	0.10	0.703
1982	0.20	0.678
1983	0.20	0.703

(a) This includes mechanics training and model years 1972-1986.

Results for all stringency factors and beginning model years can be found in Table 3-3.

3.2 REDUCTION REQUIREMENTS OF I/M PROGRAM TO MEET NAAQS FOR PHOTOCHEMICAL OXIDANTS

3.2.1 Introduction

Since the minimum requirements of an inspection and maintenance program may not be adequate for attainment of the standard for photochemical oxidants, an analysis of the 1987 VOC emission levels for Pulaski County and those required to meet the NAAQS for photochemical oxidants was done.

First, the 1977 VOC emissions were projected to 1987 by the same methodology used in the Volatile Organic Compound Control Strategy Development For Pulaski County, Arkansas. The 1987 VOC emission level (16,762.9 tons/year) was then compared to the VOC emission levels required for each of the five scenarios (calculated by the percent reductions needed from the 1977 baseline year VOC emission levels). The 1987 VOC emission levels required and the additional reductions needed to meet the standard for photochemical oxidants are shown in Table 3-4.

TABLE 3-3. PULASKI COUNTY LDV EXHAUST EMISSSION FACTORS FOR 1987 WITH INSPECTION/MAINTENANCE [a]

START I/M[b] PROGRAM	STRINGENCY FACTOR	EXHAUST EMISSION FACTOR WITH I/M OPTION[c] (gms/mile)
1981	0.10	0.703
	0.20	0.662
	0.30	0.637
	0.40	0.620
	0.50	0.604
1982	0.10	0.728
	0.20	0.678
	0.30	0.653
	0.40	0.629
	0.50	0.620
1983	0.10	0.744
	0.20	0.703
	0.30	0.678
	0.40	0.653
	0.50	0.637

(a) These are Pulaski County's LDV non-methane hydrocarbon exhaust emission factors for different inspection maintenance starting dates and stringency factors. Mechanic's training was included in all of the above analyses. The model years included in the inspection maintenance program were 1972-1986. The analysis was also conducted for the model years 1972-1987. As can be seen in the Table A-3 there was no difference in the emission factors when using either 1986 or 1987 as the latest model year.

(b) The inspection maintenance starting dates were based on the I/M implementation deadlines that were explained earlier.

(c) The minimum LDV exhaust emission factor required for non-methane hydrocarbons is 0.726 gm/mile.

TABLE 3-4. VOC EMISSION REDUCTIONS REQUIRED TO MEET NAAQS FOR PHOTOCHEMICAL OXIDANTS IN 1987[a]

SCENARIO	% REDUCTIONS REQUIRED OVER 1977 EMISSIONS	EMISSION REDUCTIONS[b] ACHIEVABLE BY 1987 (%)	1987 VOC EMISSIONS REQUIRED[c]		1987 MOTOR VEHICLE EMISSIONS REQUIRED[d]	
			TOTAL (Tons/Year)	% ADDITIONAL REDUCTIONS	TOTAL (Tons/Year)	% ADDITIONAL REDUCTIONS
1	45.5	42.6	15905.1	5.12	4641.6	15.60
2	36.4	42.6	18560.8	0.00	5499.4	0.00
3	33.3	42.6	19465.5	0.00	5499.4	0.00
4	22.2	42.6	22704.8	0.00	5499.4	0.00
5	46.7	42.6	15554.9	7.21	4291.4	21.97

(a) These are the VOC emission reductions required from the baseline year (1977) emissions to meet the NAAQS for photochemical oxidants.

(b) This represents the amount of reductions achievable in emissions from 1977 to 1987 after projecting out the baseline year emissions (1977) and applying RACT. This is explained in the VOC Control Strategy document for Pulaski County. (11)

(c) 1987 VOC Emissions Required:
1.) Total = the total 1987 VOC emission level required to meet the photochemical oxidant standard for each scenario.
2.) % Additional Reductions = the reductions from the projected 1987 emission level to meet the photochemical oxidant standard for each scenario (1987 VOC emissions = 16,762.9 tons/year)

(d) 1987 Motor Vehicle Emissions Required:
1.) Total = the maximum level of VOC emissions from motor vehicles (when motor vehicles are the only source of reduction) in order to meet the photochemical oxidant standard for each scenario.
2.) % Additional Reductions = the % reductions needed from the 1987 motor vehicle emissions (5499.4 tons/yr) to meet the standard at each scenario (when motor vehicles are the only source being reduced).

Additionally, the 1987 motor vehicle VOC emission levels needed and reductions required from the 1987 emission level (5,499.4 tons/year) to meet the NAAQS for photochemical oxidants are also shown in Table 3-4. These represent the reductions and emission levels from highway motor vehicles necessary if they are the only source being controlled beyond the previously applied RACT on stationary sources.

Table 3-4 shows that for Scenarios 2, 3 and 4 there will be no additional emission reductions needed from the 1987 level to meet the NAAQS for photochemical oxidants. But for Scenarios 1 and 5 there are additional reductions of 15.6 and 22.0% needed, respectively, from the 1987 highway motor vehicle emission level to attain the standard.

The following sections will describe the inspection and maintenance programs necessary to meet the standard for photochemical oxidants by 1987 under Scenarios 1 and 5.

3.2.2 Highway Motor Vehicle Inspection and Maintenance Programs

3.2.2.1 Highway Motor Vehicles VOC Emissions with LDV I/M Parameters

Emission factors and VOC emissions for highway motor vehicles were calculated with inspection and maintenance parameters applied only to light duty vehicles. Emission factors were calculated using a weighted average speed of 43.6 mph. All other data entered into the mobile source emissions model were the same as stated previously (Appendix A).

VOC emissions for highway motor vehicles with an LDV I/M program were calculated for 1987 by the following equation:*

$$\text{1987 VOC Emissions (tons/year)} = 16{,}657.3 \text{ (tons/year)} \times \frac{\text{1987 } E_f}{7.42} \times 1.346$$

*Since reduction credits are the same regardless of inspection and maintenance option (i.e., central facility idle mode, central facility loaded mode, decentralized facility idle mode, etc.) this equation applies to all I/M options.

where: 16,657.3 = 1977 VOC emissions for highway motor vehicles

$1987\ E_f$ = 1987 Emission factor for highway motor vehicles with an LDV I/M program (1987 E_f found in Table 3-5).

7.42 = 1977 highway motor vehicle emission factor at 43.6 mph

1.346 = VMT growth from 1977 to 1987 (projection factor obtained FHWA and Arkansas State Highway & Transportation Department).

Emission factors and VOC emissions in 1987 for highway motor vehicles with an LDV I/M program can be found in Table 3-5.

3.2.2.2 Highway Motor Vehicle VOC Emissions With LDV, LDT1, LDT2 and MC Included in the I/M program

Emission factors and VOC emissions were calculated in the same manner as in the previous section (Highway motor vehicle VOC emissions with LDV I/M options), the difference being that the inspection and maintenance program includes light duty vehicles (LDV), light duty trucks 1 (LDT1), light duty trucks 2 (LDT2) and motorcycles (MC). All input parameters for the I/M options (Table A-1) and other data required by the Mobile Source Emissions Model were the same. The additional emission reductions (motor vehicle 1987 emission factors and VOC emissions) by including the above vehicles in the I/M program can be found in Table 3-6.

The summary of the inspection and maintenance programs needed to attain the NAAQS for photochemical oxidants by 1987 are in Table 3-7.

TABLE 3-5. PULASKI COUNTY'S 1987 EMISSION FACTORS AND VOC EMISSIONS FOR HIGHWAY MOTOR VEHICLES WITH LDV I/M OPTIONS[a]

START I/M PROGRAM	STRINGENCY FACTOR	1987 EMISSION[b] FACTORS WITH I/M (GMS/MILE)	1987 VOC EMISSIONS WITH LDV I/M OPTIONS (TONS/YEAR)
1981	0.10	1.55	4,683.6
	0.20	1.51	4,562.7
	0.30	1.49	4,502.3
	0.40	1.47	4,441.8
	0.50	1.46	4,411.6
1982	0.10	1.58	4,774.2
	0.20	1.53	4,623.1
	0.30	1.50	4,532.5
	0.40	1.48	4,472.1
	0.50	1.47	4,441.8
1983	0.10	1.60	4,834.7
	0.20	1.55	4,683.6
	0.30	1.53	4,623.1
	0.40	1.50	4,532.5
	0.50	1.49	4,502.3

(a) The above emission factors and VOC emissions are for all of Pulaski's highway motor vehicles and include both exhaust and crankcase (evaporative) emissions. The LDV I/M options had mechanic's training and the model years included in the program were 1972-1986 (or 1987).

(b) The 1987 emission factor without I/M is 1.82 gms/mile.

TABLE 3-6. PULASKI COUNTY'S 1987 EMISSION FACTORS AND VOC EMISSIONS FOR HIGHWAY MOTOR VEHICLES WITH I/M ON LDV, LDT1, LDT2, AND MC[a]

START I/M PROGRAM	STRINGENCY FACTOR	1987 EMISSION[b] FACTORS WITH I/M (GMS/MILE)	1987 VOC EMISSIONS WITH I/M (TONS/YEAR)
1981	0.10	1.50	4,532.5
	0.20	1.45	4,381.4
	0.30	1.41	4,260.5
	0.40	1.39	4,200.1
	0.50	1.37	4,139.7
1982	0.10	1.54	4,653.4
	0.20	1.47	4,441.8
	0.30	1.43	4,321.0
	0.40	1.40	4,230.3
	0.50	1.39	4,200.1
1983	0.10	1.56	4,713.8
	0.20	1.51	4,562.7
	0.30	1.47	4,441.8
	0.40	1.43	4,321.0
	0.50	1.41	4,260.5

[a] The above emission factors and VOC emissions are for all of Pulaski County's highways motor vehicles and includes both exhaust and crankcase (evaporative) emissions. The I/M program was for light duty vehicles (LDV), light duty trucks 1 (LDT1), light duty trucks 2 (LDT2), and motorcycles (MC). The I/M program also included mechanics training and was for the model years 1972-1986 (or 1987).

[b] The 1987 emission factors without I/M is 1.82 gms/mile.

TABLE 3-7. STRINGENCY FACTORS REQUIRED BY I/M PROGRAMS TO MEET NAAQS FOR PHOTOCHEMICAL OXIDANTS[a]

SCENARIO	YEAR START I/M PROGRAM	I/M PROGRAM INCLUDES (FLEET MIX)	STRINGENCY FACTOR (%)	EMISSION FACTOR (GMS/MILE)	MOTOR VEHICLE VOC EMISSIONS[b] (TONS/YEAR)
SCENARIO 1	1981	LDV	20	1.51	4,562.7
		LDV, LDT1, LDT2, MC	10	1.50	4,532.5
	1982	LDV	20	1.53	4,623.1
		LDV, LDT1, LDT2, MC	20	1.47	4,441.8
	1983	LDV	30	1.53	4,623.1
		LDV, LDT1, LDT2, MC	20	1.51	4,562.7
SCENARIO 5	1981	LDV	>50	N/A	N/A
		LDV, LDT1, LDT2, MC	30	1.41	4,260.5
	1982	LDV	>50	N/A	N/A
		LDV, LDT1, LDT2, MC	40	1.40	4,230.3
	1983	LDV	>50	N/A	N/A
		LDV, LDT1, LDT2, MC	50	1.41	4,260.5

(a) These are the stringency factors required to meet the NAAQS for photochemical oxidants for the two different I/M programs: 1. I/M program includes light duty vehicles only and 2. I/M program includes light duty vehicles, light duty trucks 1 and 2, and motorcycles. Each of these I/M programs include model years 1972-1986.

(b) The motor vehicle VOC emissions required for each scenario to meet the NAAQS for photochemical oxidants are: 1. scenario 1 = 4,641.6 tons/year and 2. scenario 5 = 4,291.4 tons/year.

SECTION 4

COMPARATIVE EVALUATION OF INSPECTION AND MAINTENANCE PROGRAM OPTIONS FOR PULASKI COUNTY

4.1 DESCRIPTION OF I/M OPTIONS

There are four options for inspection and maintenance programs that are being evaluated for implementation in Pulaski County. These options are as follows:

1. Idle mode test conducted at state operated stations (centralized facility),

2. Idle mode test conducted at contractor operated stations (centralized facility),

3. Idle mode test conducted at private garages or service stations (decentralized facilities),

4. Loaded mode test conducted at contractor operated stations.

The following sections will provide a general evaluation of the benefits of I/M programs as well as a comparative analysis of the options being considered for Pulaski County.

4.2 BENEFITS OF INSPECTION AND MAINTENANCE PROGRAMS

The purpose of this sub-section is to give a general overview of the benefits that would result if an inspection and maintenance program is implemented.

4.2.1 Reduction In Emissions

One of the major benefits, and the primary reason for having an I/M program is for reducing VOC emissions. A reduction in these pollutant levels should result in improved air quality in the Pulaski County area. Since highway motor vehicles are the major contributor to VOC emission levels in Pulaski County, it will be possible to attain the NAAQS for photochemical oxidants with an inspection and maintenance program. The stringency factors required and the vehicle population needed to meet the photochemical oxidant standard by 1987 are shown in Table 4-1. The impact of I/M on the total emission reduction is presented in Table 4-2.

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TABLE 4-1. STRINGENCY FACTORS REQUIRED TO MEET LDV EXHAUST EMISSION REQUIREMENT AND NAAQS FOR PHOTOCHEMICAL OXIDANTS

I/M PROGRAM GOAL	START I/M PROGRAM	STRINGENCY FACTOR (%) LDV[b]	STRINGENCY FACTOR (%) LDV, LDT1, LDT2, MC[c]
I/M LDV EXHAUST EMISSION[a] FACTOR REQUIREMENT	1981	10	N/A
	1982	20	N/A
	1983	20	N/A
MEET NAAQS FOR PHOTOCHEMICAL OXIDANTS			
SCENARIO 1	1981	20	10
	1982	20	20
	1983	30	20
SCENARIO 5	1981	>50	30
	1982	>50	40
	1983	>50	50

(a) The I/M light duty exhaust emission requirement is to reduce LDV exhaust emissions by 25%.

(b) I/M program only includes light duty vehicles

(c) I/M program includes light duty vehicles (LDV), light duty trucks 1 (LDT1), light duty trucks 2 (LDT2) and motorcycles (MC).

TABLE 4-2. IMPACT OF INSPECTION AND MAINTENANCE ON OVERALL EMISSION REDUCTIONS[a]

I/M OPERATING PERIOD	STRINGENCY FACTOR	1987 VOC EMISSIONS (Tons/Year)		% REDUCTION[d]	
		LDV[b]	LDV, LDT1, LDT2, MC[c]	LDV	LDV,LDT, LDT2, MC
1981-1987	0.10	15,947.1	15,796.0	4.87	5.77
	0.20	15,826.2	15,644.9	5.59	6.67
	0.30	15,765.8	15,524.0	5.95	7.39
	0.40	15,705.3	15,463.6	6.31	7.75
	0.50	15,675.1	15,403.2	6.49	8.11
1982-1987	0.10	16,037.7	15,916.9	4.33	5.05
	0.20	15,886.6	15,705.3	5.23	6.31
	0.30	15,796.0	15,584.5	5.77	7.03
	0.40	15,735.6	15,493.8	6.13	7.57
	0.50	15,705.3	15,463.6	6.31	7.75
1983-1987	0.10	16,098.2	15,977.3	3.96	4.69
	0.20	15,947.1	15,826.2	4.87	5.59
	0.30	15,886.6	15,705.3	5.23	6.31
	0.40	15,796.0	15,584.5	5.77	7.03
	0.50	15,765.8	15,524.0	5.95	7.39

(a) VOC emission reductions over the 1987 level (16,762.9 tons/year) without an inspection and maintenance program. Each inspection and maintenance program includes mechanics training and model years 1972-1986.

(b) This is for an inspection and maintenance program that includes light duty vehicles only.

(c) Inspection and maintenance program includes light duty vehicles (LDV), Light duty trucks 1 (LDT1), light duty trucks 2 (LDT2), and motorcycles (MC).

(d) This is the percent reduction in 1987 VOC emissions each I/M program shows over the total 1987 VOC emission level (16,762.9 tons/year) for Pulaski County.

4.2.2 Gasoline Fuel Savings and Engine Performance

With the implementation of an inspection and maintenance program there should be a positive effect on vehicle performance. This results from the fact that in order to reduce hydrocarbon emissions, efficient combustion of the fuel (gasoline) is necessary. In order to maintain efficient combustion, the factors influencing the burning of the fuel must be properly operating. According to EPA's Office of Air, Noise, and Radiation, a fuel savings of approximately 5 percent results from the failed vehicles that are repaired[5]. This means that the overall fuel savings is the stringency factor (failure rate) times the 5 percent savings in fuel for each failed vehicle. Table 4-3 shows the fuel savings and the percent reduction over the total estimated gasoline fuel consumption in 1987 for Pulaski County.

4.3 INSPECTION AND MAINTENANCE PROGRAM COSTS

This section describes the costs associated with implementing the four options considered for Pulaski County and described in Section 4.1. The total program costs for the four options are divided into four categories as follows: Capital costs, operating costs, administrative costs, consumer protection costs. Capital costs for land and buildings were obtained from several commercial real estate developers and builders in Pulaski County. Test equipment costs were obtained directly from manufacturers of the equipment. The four options are described in the following sections with the idle mode tests at central stations combined for state and contractor operated facilities. Since capital costs for both these options are the same, only the administrative costs will differ.

4.3.1 Idle Mode Test Conducted at State or Contractor Operated Stations

4.3.1.1 Capital Costs - Facilities, Land and Equipment

4.3.1.1.1 Facilities

The two major design parameters influencing the size of an idle mode emission test facility are 1) required number of inspection lanes, and 2) office space needed to support inspection lane operations.

TABLE 4-3. GASOLINE FUEL SAVINGS FOR INSPECTION AND MAINTENANCE PROGRAMS AT DIFFERENT STRINGENCY FACTORS

STRINGENCY FACTOR	FUEL SAVINGS LDV[a] (GALS.)	FUEL SAVINGS LDV[a] %REDUCTION[c]	FUEL SAVINGS LDV, LDT1, LDT2, MC[b] (GALS.)	FUEL SAVINGS LDV, LDT1, LDT2, MC[b] %REDUCTION[c]
0.10	914,493	0.40	1,052,293	0.46
0.20	1,828,986	0.80	2,104,586	0.92
0.30	2,743,479	1.20	3,156,880	1.39
0.40	3,657,972	1.61	4,209,173	1.85
0.50	4,572,465	2.01	5,261,466	2.31

(a) These are the gasoline fuel savings for an inspection and maintenance program that includes light duty vehicles (LDV) only.

(b) These are the gasoline fuel savings for an inspection and maintenance program that includes light duty vehicles (LDV), light duty trucks 1 (LDT1), light duty trucks 2 (LDT2) and motorcycles (MC).

(c) This represents the percent reduction over the projected 1987 total gasoline consumption (227,769,124 gals.) for all motor vehicles.

The number of inspection lanes needed to test the vehicle population annually is dependent upon the following factors: (1) the vehicle population of the area under study, (2) the stringency factor, (3) the percent of vehicles exempt from inspection,and (4) the annual throughput capacity of an inspection lane. The procedure to determine the number of inspection lanes involves two steps: (1) calculating the number of vehicles to be tested and (2) dividing that number by the estimated annual vehicle throughput capacity of an idle mode inspection lane. The following two formulas meet the criteria for steps 1 and 2 mentioned above:

(1) $V_T = V_P + R - E$

V_T = Vehicle Tests/Year

V_P = Vehicle Population

R = Number of vehicles required to be retested after repairs

$R = S.F. \times V_P$

S.F. = Stringency Factor

E = Number of vehicles exempt from emission test.

(2) $L = V_T \div C$

L = Number of inspection lanes

V_T= Vehicle tests/year

C = Idle mode lane vehicle throughput capacity/year.

The number of inspection lanes required in Pulaski County is based upon the following information:

The number of vehicles registered in Pulaski County in 1982 based on historical growth trends will equal approximately 268,300 vehicles. This figure is comprised of the following components:

VEHICLE CLASSIFICATION	PROJECTED 1982 REGISTRATION[6]
LDV (Light Duty Vehicles)	195,500
Pickups	47,800
Motorcycles	10,000
Trucks	15,000
TOTAL	268,300

The number of vehicles to be retested is a function of the stringency factor. Table 3-7 shows that the stringency factor will probably fall between 20% and 30%.

It is recommended that the vehicles exempt from emission testing include first year vehicles and vehicles prior to the 1972 model year. Vehicles less than one year old are not expected to show a significant deterioration in their emission control systems. The Emission Control System performance warranty in Section 207(b) of the Clean Air Act requires the automobile manufacturer to bear the cost of repairing a properly maintained vehicle which fails an EPA approved emission test within 24 months or 24,000 miles of the original sale to the ultimate purchaser. Since including pre-1972 vehicles from the I/M program would not have any adverse effect on the air quality, and their repair costs may be a significant portion of the value of the vehicle, their exemption is recommended.

Vehicle registration data for 1976 reveals that 9.6% of vehicles in Pulaski County would be exempt from testing under this plan, based upon the following:

Vehicle Population = 268,300
Stringency Factor = 25%
Percent of Exempt Vehicles = 9.6

The total number of vehicles required to be tested is:

$$V_T = V_P + R - E$$
$$V_T = 268,300 + (.25)(268,300) - (.096 \times 268,300)$$
$$V_T = 309,618$$

Based upon 2,000 hours of inspection per lane per year and a 21 car per hour per lane inspection capacity, one idle mode inspection lane can test 42,000 vehicles per year. The required number of inspection lanes is calculated as:

$$L = V_T \div C$$
$$L = 309,618 \text{ tests/year} \div 42,000 \text{ tests/lane}$$
$$L = 7.37 \text{ or } 8$$

Assuming that an idle mode test lane can test 42,000 ± 2,100 vehicles per lane, eight test lanes are required in Pulaski County. Eight lanes would allow for an increase of 26,382 inspection tests before the need for an additional ninth lane. According to vehicle population growth trends, an increase of 26,382 tests will not occur until 1986.

Although eight test lanes are necessary in Pulaski County, not all of the lanes need to be located at one facility. In order to provide convenience to the motor vehicle owners, a combination of facility sizes could be operated. The combinations are two 4-lane test stations, or two 3-lane stations and one 2-lane station. Figure 4-1 shows six potential sites for central station inspection facilities. These sites were selected on the basis of convenience to the majority of the population, availability of sufficient land area, and zoning requirements. To clarify the locations on the map, the locations of the sites and approximate land costs are as follows:

Site No.	Location	Cost ($/sq. ft.)
1	Interstate 40 and 67-167	0.90 - 2.00
2	Roosevelt Road Industrial Park	0.50 - 1.50
3	Little Rock Industrial District	0.75 - 1.50
4	Chicot Road near Interstate 30	0.50 - 1.25
5	Colonel Glenn Road near Interstate 430	0.80 - 2.00
6	Kanis Road near Interstate 430	0.46

These sites can be used for the following combinations of facilities:

Number of Facilities Desired	Number of Lanes/Site	Possible Site Location
1	1 - 8	2 or 3
2	1 - 4	1
	1 - 4	3, 4, 5 or 6
3	1 - 3	1
	1 - 3	3
	1 - 2	5, 6

The selection of an inspection site should be based upon population density, accessibility to the general public, growth trends of the county, land availability, and proper zoning. Of the 330,000 persons living in the 805 square mile area of Pulaski County, approximately 145,100 reside within the city limits of Little Rock and 63,100 live within the city limits of North Little Rock. The other major concentrations of population are located northeast of North Little Rock along Route 67-167 and within five

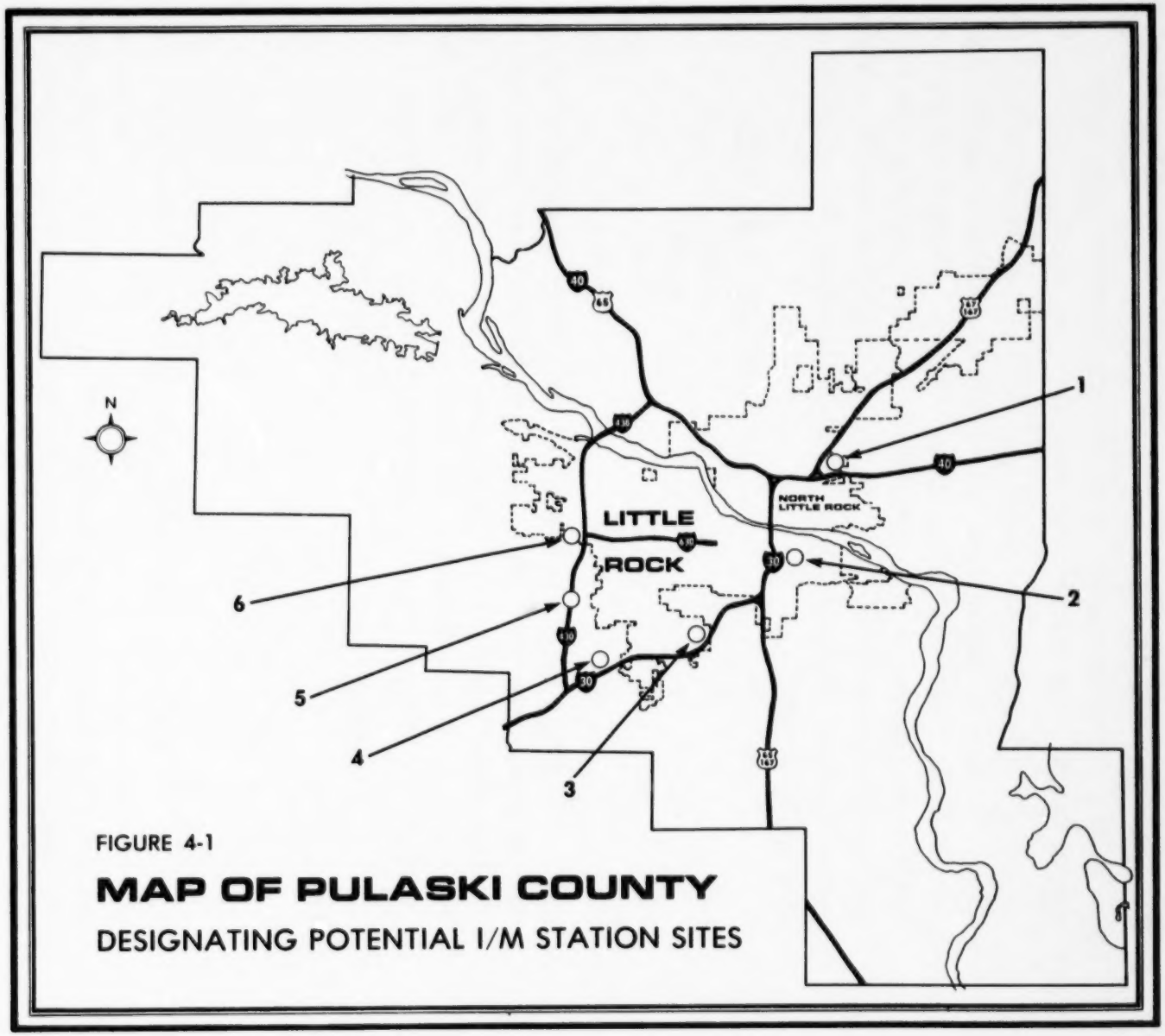

FIGURE 4-1

MAP OF PULASKI COUNTY

DESIGNATING POTENTIAL I/M STATION SITES

miles of the interstate highway system surrounding Little Rock south of the Arkansas River. The western portion of the county is sparsely populated. A station or series of stations built near the interstate road system encircling Little Rock would be the most accessible to motorists.

Lane Size - The inspection process involves the following three steps: (1) vehicle registration, (2) exhaust emission test, and (3) obtaining test results and either a pass or fail sticker. In order for the complete testing process to be operated safely and efficiently, each step would require a lane 20 feet wide and 30 feet long; therefore, the complete lane would be 20'x90' or 1800 ft^2. The total lane space for the different size facilities are:

NUMBER OF LANES	TOTAL LANE SPACE (FT^2)
8	14,000
4	7,200
3	5,400
2	3,600

Office Space - In addition to lane space, ample office space must be provided for the needs of the public for the operation and administration of the test facility. These needs include administrative offices, storage space, a gas calibration room, a waiting room and restrooms. The following office space should be sufficient in meeting the criteria:

NUMBER OF LANES	OFFICE SPACE (FT^2)
8	2,000
4	1,500
3	1,500
2	1,200

Construction Costs - The major components of construction costs for an inspection facility are: (1) the building shell, (2) office space, including lights, heat and air conditioning, (3) pit ventilation and blowers for removal of exhaust gas, (4) utility requirements, and (5) pavement for lanes and stacking area (waiting lines). The construction of a turnkey operation inspection lane station with the major components listed above would cost approximately $30 per square foot, based on estimates from real estate developers in Pulaski County. Table 4-4 lists lane space, office

space, total facility area, and construction costs for different lane size inspection stations.

TABLE 4-4. SPACE REQUIREMENTS AND COSTS FOR I/M FACILITIES

NUMBER OF INSPECTION LANES	LANE SPACE FT^2	OFFICE SPACE FT^2	TOTAL FACILITY AREA FT^2	FACILITY COSTS @\$30/FT^2
8	14,400	2,000	16,400	492,000
4	7,200	1,500	8,700	261,000
3	5,400	1,500	6,900	207,000
2	3,600	1,200	4,800	144,000

4.3.1.1.2 Land

The inspection station(s) should be built with sufficient land for the inspection and administrative building, stacking area, and for expansion as the vehicle population in the county increases. The optimum land/building ratio described by Pulaski County developers is approximately 10:1. The total land area for the buildings listed in Table 4-4, therefore, are as follows:

NUMBER OF LANES	BUILDING AREA (FT^2)	LAND AREA (FT^2)
8	16,400	164,000
4	8,700	87,000
3	6,900	69,000
2	4,800	48,000

4.3.1.1.3 Equipment Costs

Equipment costs for an idle mode test consists of exhaust analyzers and data collection equipment. A centralized system would require that the exhaust analyzer meet the specifications described earlier as well as be durable enough to meet the demand of the high volume of inspections required.

An analyzer with HC, CO analysis and scale readout will cost around \$4,000, while an analyzer with HC, CO analysis and digital readout can be purchased for around \$5,000. In some states, CO_2 is tested in order

to determine the extent to which the exhaust gas has been diluted and thus giving a more accurate HC emission level reading. A printout machine would be required for each analyzer in order for the vehicle owner to obtain test results. The printout machines are currently available for approximately $2,500. In order that sufficient equipment be on hand in case of an analyzer or printer malfunction, ten total units would be required for eight inspection lanes to prevent testing delays. The cost for these ten units would be approximately $70,000.

To obtain the equipment costs per lane, the eight lanes would absorb the cost of ten units resulting in $8,750 per lane in equipment costs. Table 4-5 shows the total capital requirements for eight inspection lanes, with the combination of facilities described earlier.

TABLE 4-5. CAPITAL COST REQUIREMENTS FOR I/M FACILITIES

I. FACILITY CONFIGURATION: One 8-Lane Facility

POTENTIAL SITE SELECTION: 2, 3

ITEM	COST
Construction	$492,000
Land	196,800[a]
Test Equipment	35,000
TOTAL	$723,000

II. FACILITY CONFIGURATION: Two 4-Lane Facilities

ITEM	Station 1 Potential Site - 1 COST	Station 2 Potential Sites - 3, 4, 5, 6 COST
Construction	$261,000	$261,000
Land	126,150[b]	87,000[c]
Test Equipment	35,000	35,000
TOTAL	$422,150	$383,000
TOTAL CAPITAL COST =	$805,150	

III. FACILITY CONFIGURATION: Two 3-Lane Facilities, One 2-Lane Facility

ITEM	Station 1 - 3 Lanes Potential Site - 1 COST	Station 2 - 3 Lanes Potential Site - 3 COST	Station 3 - 2 Lanes Potential Sites - 5, 6 COST
Construction	$207,000	$207,000	$144,000
Land	100,050[d]	69,000[e]	36,000[f]
Test Equipment	26,250	26,250	17,500
TOTAL	$333,300	$302,250	$197,500
TOTAL CAPITAL COST =	$833,050		

(a) $1.20 ft^2

(b) $1.45 ft^2

(c) $1.00 ft^2

(d) $1.45 ft^2

(e) $1.00 ft^2

(f) $0.75 ft^2

4.3.1.2 Operating Costs

Personnel - Each inspection facility requires a sufficient number of personnel to assure efficient operation of the station, thereby reducing waiting time for the vehicle owners. Staff requirements include a station manager, assistant manager, 2.5 inspectors per inspection lane, plus clerical support. The following requirements are presented for each of the three combinations of facilities based on personnel requirements in existing I/M programs in other states:

A. ONE 8-LANE STATION

1 Station Manager
1 Assistant Manager
20 Inspectors
2 Secretaries
24 TOTAL EMPLOYEES

B. TWO 4-LANE STATIONS

Station 1	Station 2
1 Station Manager	1 Station Manager
1 Assistant Manager	1 Assistant Manager
10 Inspectors	10 Inspectors
1 Secretary	1 Secretary
13 Total Employees	13 Total Employees

26 TOTAL EMPLOYEES

C. TWO 3-LANE STATIONS PLUS ONE 2-LANE STATION

Station 1 - 3 Lanes	Station 2 - 3 Lanes	Station 3 - 2 Lanes
1 Station Manager	1 Station Manager	1 Station Manager
1 Assistant Manager	1 Assistant Manager	1 Assistant Manager
8 Inspectors	8 Inspectors	5 Inspectors
1 Secretary	1 Secretary	1 Secretary
11 Total Employees	11 Total Employees	8 Total Employees

30 TOTAL EMPLOYEES

Administrative Costs - The structure and functions of an administrative staff for a centralized station I/M program would differ according to whether the program is operated by the state or a private contractor. The major functions of an administrative staff include:

(1) Development and setting of emission standards
(2) Collecting and interpreting emission data
(3) Overseeing station operations
(4) Evaluating program success
(5) Development of a mechanic training program
(6) Evaluating equipment
(7) Ensuring quality control for consumers
(8) Implementing a consumer information program.

Under a contractor operated program both the contractor and state would require administrative staffs. The eight major functions of an administrative staff mentioned above would be divided between the two staffs. The following staffs should be able to perform these major responsibilities:

CONTRACTOR STAFF

1 Region Director
1 Assistant
2 Data Key Punch Personnel
1 Secretary
5 TOTAL EMPLOYEES

STATE ADMINISTRATIVE STAFF

1 Director
1 Assistant
2 Engineers
1 Secretary
5 TOTAL EMPLOYEES

Consumer Protection - Consumer Protection Costs include the following:

(1) Mechanic Training Program
(2) A data collection system including emission repair information
(3) Public Information Program.

The costs of a mechanic training program consists of two phases: (1) educating supervisory personnel, and (2) training future inspectors who perform the repair work associated with vehicle emissions. The number

of instructors and inspectors is dependent upon the number of vehicles requiring repair. Based on a 25% stringency factor, a 9.6% exemption rate and 268,300 vehicles tested per year, approximately 67,000 vehicles will require repair to some degree. The number of inspectors needed to perform repair work is further based on the following:

125 repair stations/100,000 vehicles recommended
2 inspectors/1 station

$$67{,}000 \text{ vehicles} \times \frac{125 \text{ stations}}{100{,}000 \text{ vehicles}} = 84 \text{ repair stations}$$

$$\frac{2 \text{ inspectors}}{\text{repair station}} \times 84 \text{ repair stations} = 168 \text{ inspections}$$

Servicing of failed vehicles would require 84 repair stations and 168 inspectors.

The Colorado State University offers a two-phase training program for supervisory personnel. Phase I consists of a one-week workshop during which instructors are trained in

(1) laws and regulations of an inspection and maintenance emission program
(2) equipment use
(3) trouble shooting
(4) actual repair work.

The cost for the workshop ranges between $4,000 and $5,000 to train up to 24 instructors. The cost includes two experts in emission repair work to travel to different sections of the country and train instructors. The cost of Phase II instructor training is based upon the number of classes required to train the instructors. Each class consists of 16 hours of instruction. Upon completing the course, the instructors are required to pass a written test on emission inspection repair. Each class can handle up to 15 instructors, and assuming a need for 184 inspectors, 13 classes are required.

The cost of the class is approximately $300, including the instructor fee of $200 and $100 for miscellaneous expenses. The cost for a two-phase program would be approximately $8,900 as follows:

PHASE I, $5,000	$5,000
PHASE II, 13 classes, $300/class	3,900
	$8,900

The second phase of consumer protection involves data collection of repair information. A repair station and certified repair mechanic should be given a code number which, along with type and cost of repair, should be recorded and collected by the agency staff involved with data collection. This would assist in ensuring quality control among the repair industry.

The third aspect of consumer protection costs involves a public information program. Several I/M programs in the nation have experienced adverse public reaction to the programs when first presented to the public. An extensive I/M public information program should be implemented through the media as well as having regulatory personnel hold public meetings on the benefits of an I/M program. The State of Arizona, which had an extensive I/M program, spent approximately 23¢ per vehicle in the program area for public relations purposes. Applying this to Pulaski County, between $40,000 and $50,000 would be required for a public information program.

4.3.2 Idle Mode Test Conducted at Private Garages or Service Stations

Since there are no capital costs for land or buildings for this option, the major costs of an idle mode test conducted at private garages or service stations include:

(1) inspector training
(2) purchase of emission testing equipment
(3) quality control enforcement
(4) administrative costs.

The number of analyzers and inspectors required to perform the emission tests of an I/M program is based upon the following:

125 inspection stations/100,000 vehicles tested
2 inspectors/station
1 analyzer/station

Assuming that approximately 309,600 vehicles will be tested annually, the number of inspectors and analyzers equal:

$$309600 \times \frac{125}{100,000} = 387 \text{ stations}$$

$$\frac{2 \text{ inspectors}}{\text{station}} \times 387 \text{ stations} = 774 \text{ inspectors}$$

1 analyzer/station x 387 = 387 analyzers

Light duty exhaust emission analyzers with the same specifications as mentioned in Section 3.3.5 cost between $2,800 and $4,000. Based on an average of $3,400 per analyzer and 387 analyzers, the cost of equipment will equal $1,315,800.

The function and structure of an administrative staff would be similar to the state operated idle mode test described earlier. With the addition of quality control personnel, an adequate staff would include:

1 Director
1 Assistant
2 Engineers
1 Officer
2 Inspectors
2 Data Key Punch Personnel
2 Secretaries

The function of an officer would be to insure that inspection stations were inspecting and repairing vehicles properly by running dummy vehicle tests at randomly selected inspection stations. The inspectors would inspect each service station every 30 days for (1) facility condition, (2) qualification of inspectors performing testing and repair, and (3) instrumentation gas calibration.

Consumer protection costs for a decentralized I/M program include:

(1) Mechanic training
(2) Data collection
(3) A public information program
(4) Quality control
(5) Referee station.

The mechanic training program for a decentralized system would be a two-phase program similar to the Colorado State University described in Section 4.3.1.2. The major difference would be the greater number of supervisory personnel and inspectors requiring training. The number of inspectors required for a decentralized program was calculated at approximately 774 inspectors. Based on 15 inspectors per class, the number of Phase II classes would equal:

$$774 \text{ inspectors} \div \frac{15 \text{ inspectors}}{\text{class}} = 52 \text{ classes}$$

At $300 per 16-hour class, Phase II would cost $15,600. Phase I instructor training would cost, as explained earlier, between $4,000 and $5,000. Due to a greater number of vehicles tested under a decentralized program compared to a centralized station program, more instructors will be required to teach the inspectors. The total cost of a training program is estimated as follows:

PHASE I	$15,600
PHASE II	5,000
	$20,600

A data collection system as described earlier, in which repair information along with emission test results would be collected and analyzed by the state staff, would be sufficient for consumer protection purposes. The addition of an officer and inspectors described in administrative costs to ensure proper operations and repair by the inspection stations would supply adequate quality control. An extensive public information program similar to the Arizona program described earlier should be adequate for this I/M option, also.

The final phase of a consumer protection program would be to build a state operated referee station. The purpose of the referee station would be to allow a vehicle owner to have his vehicle tested by the state at a centralized station if that person believes that the test done at the service station or garage was not performed properly. Since only those vehicles which failed the initial emission test would be brought to the station, a one-lane facility should be adequate with a stringency factor less than 30%. States which do not have referee stations have usually converted one lane of a state-owned garage rather than build a facility

for the sole purpose of being a referee station. Such stations in other states are usually manned by 2 state inspectors.

4.3.3 Loaded Mode Test Conducted by a Contractor

The major cost differential between a loaded and idle mode inspection test conducted at one or a series of centralized stations includes: (1) the use of a dynamometer, and (2) greater number of inspection lanes due to reduced vehicle throughput capacity under a loaded 3 mode cycle test. The purpose of using a dynamometer is to test the vehicle under simulated road conditions and thus obtain better diagnostic results from the emission test. The dynamometer simulates road conditions by applying a road load onto the vehicle as it is accelerated and decelerated. Dynamometer costs are approximately $10,000, with an additional $3,000 for installation.

The annual lane throughput capacity for a loaded mode federal short or three cycle test is estimated at 37,000 vehicles/year. Based on a 25% stringency factor, a 9.6% exemption rate and a vehicle test population of 309,600 vehicles/year, the number of loaded mode test lanes would equal:

$$\frac{309{,}600 \text{ vehicles}}{37{,}000 \text{ vehicles/lane}} = 8.37 \text{ or } 9 \text{ inspection lanes.}$$

At $13,000/dynamometer, the loaded mode test will require an additional $117,000 in capital costs. The additional lane will increase the capital costs of the land and building by approximately $86,000. It should be noted that if the loaded mode test is modified by eliminating the 30 mph mode in the test, then the lane throughput capacity can match that of an idle mode test, thus not requiring the additional capital and operating costs of an additional lane. If, indeed, the throughput capacity for a loaded mode test can be increased to meet that at an idle test, then the equipment cost would equal $104,000 based on eight lanes.

The other major costs for a loaded mode test, including operating, administrative and consumer protection programs, would be the same as the idle mode test as described in the section for a contractor-operated I/M program.

4.3.4 Cost to Motorist

The actual out-of-pocket expenses for the motorist in having the vehicle inspected cannot be determined until a very detailed cost analysis is made for the entire program. One of the major factors influencing the inspection fee is whether the program will be subsidized to keep the inspection fee low or if the program will be self-supporting. The building, land and equipment costs presented in this report are based on information obtained during the fall of 1978 and are not representative of the costs that will be incurred by 1981. The inspection fee costs can be estimated based on current costs in existing programs. These range from a free inspection in the California and Chicago programs to $5 in Arizona and Oregon. It is estimated that the inspection costs in the phase II and III program in California will be $7-$8.

At an estimated inspection fee of $6 and a projected light duty vehicle population of 195,500 in 1982, approximately $1.17 million will be generated in inspection fees. This assumes that the retest of failed vehicles would be done at no charge to the motorist. If the total 1982 motor vehicle population of 268,000 vehicles is included in the I/M program, approximately $1.61 million will be generated in inspection fees. These fees collected the first year would cover the capital costs of the land, test facility and test equipment for any of the combinations of eight lane test facilities shown in Table 4-5.

APPENDIX A
INSPECTION/MAINTENANCE PROGRAM BACKGROUND DATA

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TABLE A-1. DATA INPUT INTO MOBILE 1[a]

PARAMETER	VALUE
REGION	LOW ALTITUDE
TEMPERATURE	62.5°F
SPEED	43.6 mph
CALANDER YEAR	1987
PCCO[b]	20.58%
PCHS[c]	27.28%
PCCC[d]	20.58%
VMT MIX	National Average (default option in Mobile 1)
LIGHT DUTY VEHICLE REGISTRATION DATA	Registration Data for Pulaski County[e]

[a] This was the input data used for calculating 1987 VOC emissions from highway motor vehicles in Pulaski County without I/M.

[b] PCCO = % of non-catalyst equipped LDV VMT accumulated in cold start mode.

[c] PCHS - % of catalyst equipped LDV VMT accumulated in hot transient mode.

[d] PCCC = % of catalyst equipped LDV VMT accumulated in cold start mode.

[e] National Vehicle Registeration Service July, 1976 R. C. Polk & Co., Cincinnati, Ohio.

TABLE A-2. COMPARISON OF BEGINNING MODEL YEARS FOR INSPECTION MAINTENANCE PROGRAM (a)

Beginning Model Year	Emission Factor (gms/mile)
1968	1.12
1969	1.12
1970	1.13
1971	1.13
1972	1.13*
1973	1.14
1974	1.15
1975	1.17

(a) These mobile source emission factors were calculated with the inspection maintenance program applying only to light duty vehicles. The following parameters were held constant for each of the beginning model years:

1. Calendar year = 1987
2. Speed = 43.6 mph
3. Temperature = 62.5^{o}F
4. I/M starting date = 1981
5. Stringency factor = 30%
6. Latest model year included in I/M program = 1987
7. Mechanics Training = Yes

* Since the emission factor changes each year after 1972, this year was chosen as the earliest model year to be included in the inspection maintenance program.

TABLE A-3. COMPARISON OF LDV EXHAUST EMISSION FACTORS FOR LATEST MODEL YEAR TO BE INCLUDED IN INSPECTION MAINTENANCE PROGRAM[a]

Stringency Factor	Latest Model Year Included	Emission Factor (gms/year)
0.10	1987	0.703
0.20	1987	0.662
0.30	1987	0.637
0.40	1987	0.620
0.50	1987	0.604
0.10	1986	0.703
0.20	1986	0.662
0.30	1986	0.637
0.40	1986	0.620
0.50	1986	0.604

(a) The following parameters were held constants for the above analysis:

1. Calendar year = 1987
2. Speed = 43.6 mph
3. Temperature = 62.5°F
4. I/M Begins = 1981
5. Beginning model year = 1972
6. Mechanical training = yes

REFERENCES

1. Clean Air Act, 42 U. S. C. 7401 et. seq., as amended by the Air Quality Act of 1967; Clean Air Amendments of 1970, PL 91-604; Clean Air Act Amendments of 1977, PL 95-95, August 7, 1977.

2. Volatile Organic Compound Emission Inventory for Pulaski County, Arkansas, EPA-906/9-78-004, Air and Hazardous Materials Division, EPA Region 6.

3. Mobile 1: Mobile Source Emissions Model. EPA-400/9-78-007, Office of Air, Noise, and Radiation. August 1978.

4. "Road and Street Mileages," Arkansas State Highway and Transportation Department, Division of Planning and Research, January 1978.

5. Telecommunication with EPA Office of Air, Noise and Radiation.

6. Written communication from Arkansas State Highway and Transportation Department